PHENOARCH, a multiscale phenotyping platform for plant architecture, growth rate, water use efficiency and radiation use efficiency

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Interactive exhibit

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PHENOARCH (*https://www6.montpellier.inra.fr/lepse/M3P/plateforme-PHENOARCH)* measures traits associated to the plant adaptation to climate change with a throughput of 1650 plants. Typical measured variables are the timing of the plant cycle (phyllochron, duration of phenological phases), plant growth rate in terms of area and biovolume, plant architecture in terms of ramification and angles, light interception, radiation use efficiency and water use efficiency. Soil water potential is controlled individually for each plant via scales; changes in weight are attributed to changes in soil water content after correction for the increase in plant biomass. Microclimatic data fluctuate naturally within a range fixed by users. A set of sensors measures meristem temperature, incident light, air temperature and VPD every minute. A 3D model of the greenhouse allows inferring the environmental conditions sensed by each individual plant by calculating spatial gradients in the greenhouse each day of the year. Plants are imaged every day with 12 side views and one top view, which allow reconstructing a digital 'avatar' of each plant of the platform. Calculations related to plant architecture and to individual organ size are carried out on these virtual plants. Light interception by each plant in the platform is calculated via a virtual scene consisting of the 1650 3D virtual plants in their real positions. The measured timecourses of biomass and of intercepted light, combined with local measurements of light intensity, allow estimation of radiation use efficiency. Responses to water deficit and evaporative demand can be analysed by combining time courses of leaf area or biovolume with environmental data. PhenoArch is associated to an information system for real time monitoring of experiments, post-analysis of large datasets and identification of genotypic parameters such rates, architectural parameters or sensitivities. It has been used for (i) association genetics in panels of genotypes (diversity, MAGIC or biparental crosses), (ii) in-depth analyses of smaller panels such as panels of genetic progress or introgression lines, for morphological or physiological traits, (iii) estimation of parameters of crop models that are then tested and used in the field. PhenoArch has been used with maize, rice, sorghum, wheat, apple tree and vine. It is part of the M3P facility (*https://www6.montpellier.inra.fr/lepse/M3P*) and is accessible to public or private scientists via the website of the national project Phenome-FPPN (*https://www.phenome-fppn.fr/*). Accesses have also been provided via the infrastructure EU project EPPN.